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PRUNING.

BY

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., September 23, 1903.

SIR: I have the honor to transmit herewith a paper on Pruning, written by Mr. L. C. Corbett, Horticulturist of this Bureau, and recommend that it be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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PRUNING.

INTRODUCTION.

The practical grower of trees and shrubs is frequently taken to task by the would-be tree protector because he cuts out branches which are neither broken nor dead, but are in a healthy, flourishing condition. The argument used by this critic is that in nature it is not necessary to cut out branches and otherwise mutilate trees; that, in order to allow the plant to assume its natural and normal form, no pruning should be done and that the use of the knife is detrimental to the best interests of the tree, and should therefore be discouraged. The practical grower, however, knows too well the results which follow from this laissez faire method of handling trees in orchards, parks, and other ornamental plantations.

GROWTH UNDER NATURAL AND ARTIFICIAL CONDITIONS.

Under natural conditions plants grow thickly; one crowds upon the other, and in that way all superfluous individuals as well as branches are crowded out. Under artificial conditions there is no such force at work. Plants are placed at distances which prevent this natural pruning. The increased amount of food available to plants under artificial conditions frequently excites growth, so that the distance between the different whorls of branches, which naturally develop from near the end of the growth of each season, becomes great, thus giving the plant an open form and the appearance of having been built by stories. By a judicious use of the pruning knife the gardener shortens this annual growth, thus reducing the distance between the branches formed in successive years, with the result that the tree has a more compact and symmetrical form and therefore is better suited to serve the purpose of an orchard or ornamental tree.

WHY PRUNING IS PRACTICED.

What has been said in regard to the heading-in or cutting back of orchard and ornamental trees applies with equal force to shrubs. Care should be exercised, however, in this heading-back process in order

that the plant so pruned should not assume an artificial form. The heading-in should be a corrective process rather than one which is directive; that is, the heading-in should only be sufficient to counterbalance the augmented growth which results from the increased food supply of plants grown under high culture.

Examples.—Extreme examples of the necessity of heading-back are almost invariably met with in the case of poplars grown for decorative purposes. Among orchard trees none presents greater necessity for annual treatment in this way than do the peach and the Keiffer pear, although nearly all of the fruit and ornamental trees while young require care in this particular.

PROTECTION AGAINST STORMS.

Another reason why pruning is necessary with plants grown under artificial conditions is that some of our most desirable ornamental trees and shrubs have an unfortunate natural habit of growth which results in a method of branching which makes trees unable to withstand high winds or heavy snows. It is the gardener's business, therefore, to guard against such branching and to so direct the growth of the tree as to force it to distribute its branches in such a manner as will best prevent it from being broken during high winds or heavy storms. A notable example of this undesirable system of branching is had in the silver maple. This tree almost invariably branches so as to throw two strong shoots from the point of branching, each of which grows at about the same rate, with a very narrow angle between them; the result is, that as the branches increase in size, the union between them not being perfect, severe pressure placed upon one of them has a tendency to split them apart. Everyone who has observed the silver maple has frequently seen large trees badly broken or split after severe wind storms. If the tree trainer had given careful attention to the arrangement of the branches during the early life of such trees, these undesirable results, which are so fatal to successful park adornment, might have been avoided. Pruning, then, is necessary in order that the habits of a tree which are naturally bad may be corrected.

PRUNING FRUIT TREES.

With fruit trees pruning is important because it can be used for the purpose of checking the growth as well as for the purpose of thinning the fruit. It is an old and well established maxim among fruit growers that whatever tends to check growth increases the fruitfulness of the plant. Pruning can be used to accomplish this result to a certain limited degree. Plantations which are tardy in coming into bearing may, therefore, by judicious pruning, be brought into profitable production.

Accelerating growth.—Contradictory as it may at first thought appear, pruning is frequently resorted to to accelerate or augment growth in plants. Weak growing nursery stock is frequently severely cut back during the resting period in order that all the strength of the root may be forced into the formation of a single upright stalk which will make the plant a salable nursery tree.

Rejuvenation of old trees.—Severe pruning is also resorted to with older plants for the purpose of rejuvenating them. Old apple trees and old shade trees are frequently so treated, in order to induce them to throw out strong new shoots.

Effect on fruit crops.—With such plants as the peach, which bears its fruit upon the growth of the previous year, pruning is of great importance, as the grower can reduce the crop in proportion to the capacity of the tree. Successful fruit growers thoroughly understand the importance of gauging the quantity of fruit allowed to be borne by a tree to the capacity of the tree, the ability of the tree in this respect being measured by the rate of growth, the variety, and the soil and climatic conditions to which it is subjected.

Control of disease.—Pruning is of prime importance also in controlling the action of some of our most dreaded plant diseases. The study of pear-blight, for instance, has shown that this disease is very generally communicated from plant to plant by insects, through the pollen, as they pass from blossom to blossom, or, later in the season, from shoot to shoot. It is also believed that the disease can be carried by the wind and that infection can take place while the vegetative processes are active and the tissue at the ends of the branches can easily be entered by the germs of the disease.

Pear-blight.—The way in which pruning is of service in controlling pear-blight is as follows: It is the natural tendency of the pear and the apple while young to form fruiting spurs upon the body and larger branches of the tree. These fruiting spurs produce blossoms from year to year, which are in turn as liable to be visited by bees or other insects carrying the destructive spores of the pear-blight as are the blossoms at the extremities of the branches. It is evident, therefore, that a blossom situated upon the body or larger branches of a tree becoming infected by this disease would communicate it directly to the framework of the tree, with the result that the tree would undoubtedly be fatally injured; but if these fruiting spurs are all eliminated from the body and larger main branches of the tree by careful pruning the possibility of infection in this way is overcome. The available means of gaining entrance to the tree by this parasite is confined to the smaller branches, which, if affected, can be cut away without severely injuring or disfiguring the tree. This is, in brief, the method of successfully controlling the pear-blight. It is purely a mechanical oper-

ation, but one which requires a rigid execution of the principle of *removing all fruiting spurs from the body and main framework branches of the tree* as well as cutting out all infested shoots in other parts of the tree.

Plum and peach rot.—In the case of the dreaded plum and peach rot (*Monilia fructigenia*) the ravages of the disease can be stayed to a limited extent by the removal of branches which interfere and would bring the fruits upon adjacent branches in contact, for it is well known that this disease is readily communicated from fruit to fruit if they come in contact. Thinning, then, which is a process of pruning, has for one of its primary objects the control of this disease, for it is the endeavor of successful growers of peaches and plums to have the fruits so distributed upon the branches that they shall not come in contact, even when fully developed. It is the aim of the peach grower to have the fruits at least 6 inches apart, while it is the object of the plum grower to have them 2½ to 4 inches apart.

REASONS FOR PRUNING.

The gardener, therefore, has as reasons for pruning trees the removal of dead, dying, or broken branches, the reduction of the annual growth for the purpose of correcting the habit of the plant, the removal of branches in order to prevent the breaking or disfigurement of the tree in later years, the removal of branches and fruit spurs for protection against infectious diseases, and the reduction of the annual growth in order to reduce the crop in proportion to the capacity of the tree.

APPLICATION OF THE PRINCIPLES OF PRUNING TO SPECIFIC PURPOSES.

PRUNING TREES AT PLANTING TIME.

All are agreed that trees intended either for orchard or ornamental purposes are best if nursery grown. Nursery-grown trees, however, are produced under conditions which subject them to more or less crowding, with the result that the normal development has been changed. The planter should at planting time have in mind the natural form and habits of the plants with which he is dealing and should therefore use the knife so as to bring about results which will allow the tree to assume its normal shape.

As the trees and plants are removed from the nursery, a greater or less proportion of the roots is necessarily lost in the operation of digging. If the trees are large, only the main roots will be left upon the plant, while if small, a very much larger proportion of the fine, fibrous, feeding roots can be retained. Then, too, the distance which

plants are removed has a direct bearing upon the amount of root surface which is left at planting time. Plants which can be dug and immediately reset suffer much less than do those which have to be shipped long distances. The planter should take these factors into consideration in pruning the tree at planting time.

PRUNING THE ROOTS.

As has been observed, there will be a severe loss of root area in removing the plant from the nursery, depending upon the size and age of the plant. All mutilated or dead roots should be removed, and in cutting away roots it should be the aim to make the cut in such a manner that a smooth clean surface is left, which, when the tree is placed in position, will come in contact with the moist soil either of the sides or bottom of the hole. With most of our ornamental evergreen and deciduous trees as little root area should be cut away as is practicable. Many of the fruit-bearing plants, however, such as the apple, pear, peach, plum, and grape, will stand quite severe root pruning. (See figs. 1 and 2.)

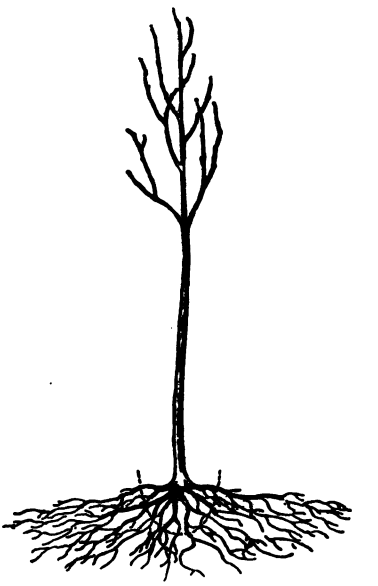

FIG. 1.—How the roots are cut at digging time.

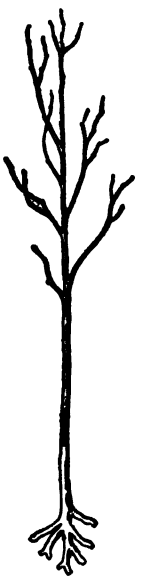

FIG. 2.—The relation of root to top in a nursery tree lifted for shipment.

Stimulation of fruit buds.—When a tree has attained to a fruit-bearing size and shows no indications of fruiting, but continues to maintain a vigorous growth of branches and is evidently barren as the result of excessive luxuriance, a judicious root pruning will have the effect of encouraging the formation of fruit buds. Trees in this condition, if root-pruned about the first of August, will receive a check to growth which will cause the formation of fruiting buds during the fall and show a flowering disposition the following spring.

The process of root pruning.—The operation is performed by digging out a circular trench at a distance of from 3 to 6 feet from the stem, according to the size and age of the tree, and from 2 to 4 feet in depth, cutting all the roots that may be encountered or can be reached. If but few strong roots

are met with, and if it appears evident that strong taproots exist, the soil should be undermined with a sharp mattock, severing all the strong roots that can be reached; the soil is then returned, being well firmed as the trench is filled, and the process is completed.

Protection against frost.—Some Asiatic conifers, such as the Japan cedar (*Cryptomeria japonica*), continue their growth so late in the season that they are overtaken by frost, to the injury of leading shoots. Many of the evergreen trees from the Pacific coast suffer in a similar manner. These plants are apt to take a second growth when the weather is moist and warm during the fall, which growth is mostly destroyed by the first frost. Root pruning in August will prevent this late growth, and the trees will pass through the winter without injury.

PRUNING THE TOP.

As the growth of the branches depends entirely upon the food supply made available to them by the roots of the plant, and since in transplanting a large proportion of the root surface is lost and the roots in their new position are not able to immediately take up food and moisture from the soil with which they come in contact, it follows that in order that the roots shall be able to furnish food for the branches and leaves the area of the top of the tree must be reduced in proportion to the loss which the root has sustained. In fact, the pruning of the top should be somewhat more severe than has been the pruning of the roots, because the demand for water which is made by the growing parts can not be so successfully met by a newly transplanted tree as by one thoroughly established.

FORMING THE HEAD.

One of the most important steps in the development of either an ornamental plantation or a commercial orchard is the proper arrangement and height of the head of the plants. With most shrubs a distinct body is not desirable. The bush form, which more nearly approaches the natural habit of the plants, is more pleasing than the tree form, but with shade trees, aside from evergreens, the true tree type is most desirable; that is, a long, clean bole reaching from the greensward to the main structural branches. With evergreens, however, the branching should be symmetrical and complete from the greensward to the topmost branches. Evergreens, particularly spruces and pines, which have lost their lower branches have also lost their beauty and value as ornamental plants or specimen trees. With deciduous trees, however, the shading of the lower branches from the thickening of the leaf canopy above discourages their growth and very frequently results in their death. It is therefore necessary that small

branches which are in any way shaded be removed. A very large part of this pruning can, however, be overcome by a judicious arrangement of the main structural branches at planting time.

How branches should be disposed.—The arrangement of the branches may be described as follows: First, the branches should be disposed at equal distances about the main stem or axis of the plant, so that as the tree grows the main branches shall completely occupy the space and provide for a symmetrical development of the tree. Second, the branches should be disposed at some distance from one another along the central axis of the tree; that is, the whorl of branches which is to be disposed equally about the body of the tree should not be in the same plane. The lower branch may be 5 or 6 feet from the turf line, the second branch should be at an angle of 33° or 45° from the first one and several inches above it rather than in the same plane with it. The third branch, which may be 66° or 90° from the first, should be from 4 to 8 inches above the second branch, and so on, until the whorl of branches around the body is complete and arranged as nearly as possible at equal distances from each other. (Fig. 3.) The reason for such an arrangement of branches is that the tree when old is much less liable to injury from heavy snows or severe winds. The union between the branch and the body is more perfect when the branches leave the main stem at different heights than when they all come off at above the same place.

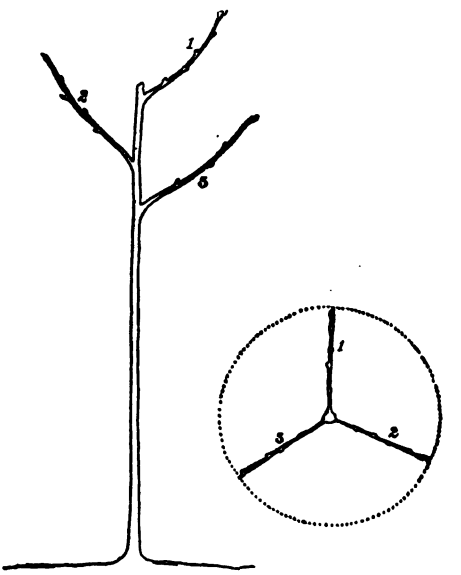

FIG. 3.—Plan of tree at planting time.

Main branches.—Again, it is more desirable to have the main structural branches of the tree composed of from three to five limbs of about equal size rather than of two. (See fig. 4.) A tree which divides into two limbs, which again subdivide to form the main head, is much more likely to split than a tree with several limbs disposed at different heights upon the main axis. It should therefore be the aim of the gardener in forming the head of the tree to provide against any natural tendency in the plant to divide in twos. This tendency, as has already been noted, is characteristic of the silver maple and to a less extent of the elm, both of which are desirable ornamental trees.

Orchard trees.—What has been stated in regard to forming the head of trees in general applies equally well to orchard trees, with the exception that in the case of orchard trees the head should be very much closer to the ground than with ornamental trees. Commercial orchards of apples and pears are nowadays headed much lower than formerly, 3 feet being a very common height for starting the head of these plants, while with the peach and plum the head is started even lower, 18 or 20 inches being a common height. The reason for this is that in certain localities where windstorms are frequent, the low-headed trees when pruned as above indicated are less likely to be broken, lose a smaller proportion of their fruit, and are less subject to injury from sun scald, as the low head of the tree serves to a certain extent as a shade for the body. The cost of harvesting the fruit from low-headed trees is much less than that of gathering from tall trees. With the low-headed trees a considerable portion of the crop can be gathered by the picker standing upon the ground, while with high-headed trees the major part of the work must be done from ladders, which greatly extends the time required to do the picking and consequently increases its cost.

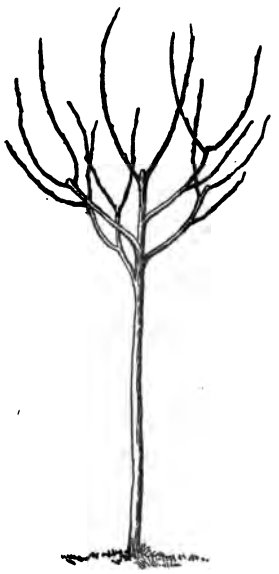

FIG. 4.—A five-branched tree at the end of the first season's growth.

AFTER PRUNING.

During the early years of the life of both ornamental and fruit trees a vigorous use of the pruning knife is frequently necessary. Trees normally make much longer natural growth during the first ten years of their existence than later. For this reason, in order to preserve a symmetrical form and to prevent the fruit being borne at the extremity of long, slender branches, careful heading-in is necessary. With pears and apples the main body branches left at planting time should not be more than 8 inches long. At the close of the first season, when pruning time arrives, the growth of that year should again be shortened to at least 1 foot and each of the main body branches should be allowed to carry not to exceed three subdivisions, each of which should be 8 inches long. The third year the same operation should be repeated and instead of allowing each subdivision to carry three branches the number should be reduced to two. The arrangement of these branches should in all cases be based upon the same principle as the arrangement of the branches on the main body of the tree. (See fig. 5.)

Habits of growth.—One additional precaution, however, is necessary, and that is that with trees which have an upright or pyramidal tendency of growth the terminal bud which is intended to form the leading branch from any primary branch should be left on the outside rather than in the center of the tree. By observing this precaution a more spreading tendency of the plant will be secured than would result from its normal growth. If, on the other hand, the tree has a decumbent habit of growth and it is desirable for any reason to prune it in a pyramidal form, the terminal bud or the bud to form the leader should be left on the opposite or inner side of the branch.

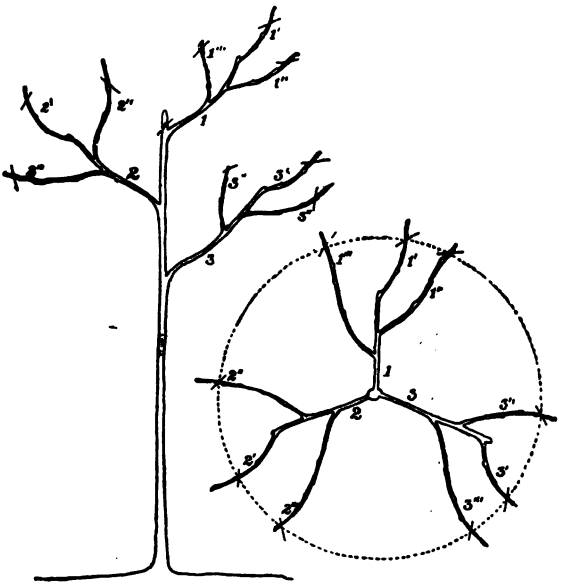

FIG. 5.—Plan of top after one year's growth in the orchard.

Plum and peach.—In the case of the plum and peach, which are shorter lived than the apple and pear, these careful precautions as to the disposition of the branches are not so important, particularly in the after pruning of the plant. The pruning at the time of forming the head, however, is fully as important with this class of fruits, because of the fact that they are much more liable to split down with heavy loads of fruit than are the apple and pear. The general rule observed in the after pruning of the peach is to shorten the annual growth about one-half. This, of course, is not always necessary, particularly during seasons of heavy crop and sparse rainfall, when the natural growth of the plant is very short. Whenever the normal growth is under 8 inches little additional pruning is necessary, but whenever it exceeds that amount heading-in will be found advantageous. In the case of the peach and plum heading-in serves the double purpose of preserving a compact, symmetrical tree and at the same time reducing the annual crop of fruit. The result is that the fruit which is allowed to remain upon the tree receives a larger amount of nourishment than would be the case were the full annual growth of the plant left and the tree permitted to bear its normal quota of fruit. Larger and better developed fruits naturally follow from such pruning.

REMOVAL OF LARGE BRANCHES.

It is not reasonable to expect that every tree planter will have observed the precautions above stated in planting and caring for his ornamental and fruit trees. It therefore frequently happens that the removal of large branches becomes a necessity. The question then arises, how shall this be accomplished with as little injury to the plant as possible; in other words, how shall the cut be made? Those familiar with the propagation of plants from cuttings, as well as those who have observed the results of pruning trees, will have noticed that when branches are cut at a certain distance from their origin the stub which is left invariably dies (as shown in fig. 6, B), decay follows, finally the rotten stub breaks off close to its origin, and a cup, which catches the rain, is left. This is also an attractive spot to many birds and rodents which are fond of nesting in such places. They assist the natural decay by excavating, and thus accelerate the work which the elements have begun. The result is that the branch which was removed for the purpose of lengthening the life of the tree and to improve its appearance has in reality been the direct cause of its early destruction.

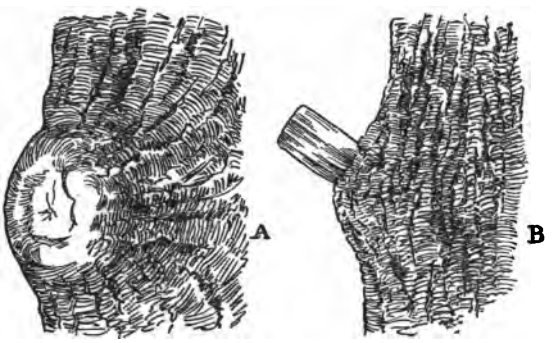

FIG. 6.—Results of correct and incorrect pruning. A, correct method; after two years; B, incorrect method.

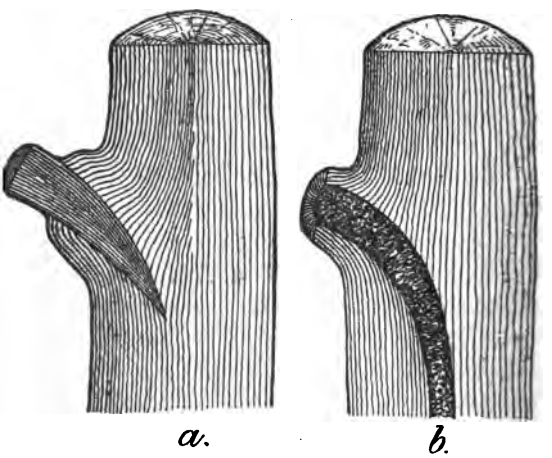

FIG. 7.—Progress of decay due to improper pruning. *a*, dead stub; *b*, decay of heart.

Decay of stub.—The decay in the stub which breaks off near its origin does not stop at that point, but the factors which have been the cause of its decay and death continue their work upon the heartwood of the plant, as illustrated in fig. 7, until the hollow trunk of the tree only remains. On the other hand, if the branch is removed at another point the wound is rapidly

covered by new growth, and in the course of two or three seasons it is practically impossible to determine where the branch formerly appeared. (See fig. 6, A.) These results, which are so important to the life of the tree and to the success of the plantation, whether ornamental or economic, are well understood by all plant physiologists. The stub which is left when the branch is removed, if cut off at some distance above its origin, invariably decays and leaves a hollow branch, while the branch which is cut off close to its origin almost invariably heals quickly, the new growth covering the wound. The accompanying illustrations (figs. 6 and 7) are taken from actual specimens.

How to remove large branches.—In order to facilitate the healing process in the plant, all wounds which are made should be left smooth; that is, if it is necessary to use a saw in removing a large branch the cut surface should be left smooth and clean, particularly around the edges.

FIG. 8.—Method of cutting a large limb which should be avoided.

FIG. 9.—How to cut off a large limb.

The saw should be sharp and should leave a clean cut, and this should in turn be made smoother by the use of the pruning knife or a sharp chisel, as the healing process starts quicker and progresses more rapidly when this precaution is observed than when a rough and jagged surface is left. It frequently happens that, in order to obtain the best results in removing large branches, two cuts should be made—that is, the branch should be sawed off 18 inches or 2 feet above the point of its origin in order to prevent splitting down and tearing off a considerable portion of bark. After the weight of the branch has been lessened by cutting away the main part, a second cut can be made and the stub held in position until the cut is completed, thus preventing the splitting down and tearing of the bark (as illustrated in fig. 8) which is likely to result from the careless removal of large branches. The evil results of splitting can frequently be overcome by cutting first on the

under side of the limb and then upon the upper side, as shown in fig. 9, so that the breaking of the tissue occurs near the middle of the wound instead of at one side. When this is the case, tearing and splitting seldom occur.

Removal of annual growth.—Where the pruning involves the removal of annual growth rather than large branches the cut should invariably be made immediately above a bud, as shown in fig. 10, *a*. If made just below a bud, or in the middle of the space between buds, that portion of the shoot left above the topmost bud invariably dies back to the bud, leaving a blackened, decaying stem, which is of no benefit to the plant and may prove a direct injury in that it provides a means of access for injurious pests.

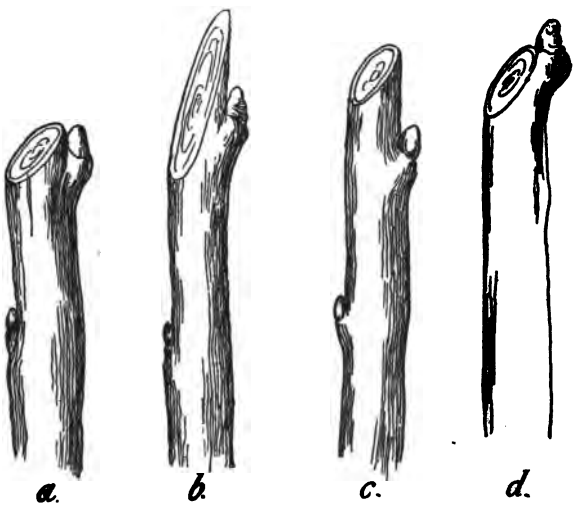

FIG. 10.—Right and wrong ways of cutting off shoots. *a*, the right way; *b*, *c*, *d*, wrong ways.

WHEN TO PRUNE.

The question frequently arises when to prune. Among the earlier horticulturists this question was often answered as follows: "Prune when your knife is sharp." This is a comparatively safe method to follow with most plants, but where the problem involves the management of extensive commercial plantations it is not so easy to prune in this miscellaneous fashion. The work must necessarily be done at some particular season and carried on in a systematic manner after some definite plan. With most orchardists and gardeners pruning can best be done during the winter or early spring months, and where the object is the removal of small branches this season is undoubtedly quite as satisfactory as any other. In fact, pruning during late spring, about the time or just previous to the beginning of growth, is particularly advantageous with the peach, because at that season, as a rule, all injury to the annual growth from winter killing will be apparent and the pruner can take advantage of this to remove all dead or injured branches and at the same time modify his plan so as to leave a maximum quantity of wood in order to secure a profitable crop of fruit, which might not be possible were the usual practice of removing one-half the annual growth followed in such seasons. With the apple and pear, which

suffer less from winter killing, the annual pruning can as well be done in February or March, in the north, as at any other season. With the grape, however, which is likely to produce a heavy flow of sap if the pruning is delayed until late in the season, it is undoubtedly best to do the pruning during the late fall and early winter months.

Unsettled questions.—There are several questions in connection with this operation which are not yet definitely settled for the different fruits. Some growers hold that late spring pruning tends to increase the fruit supply and that fall or early winter pruning increases the development of wood, particularly with the grape. But, as there are no careful records bearing upon this point, one must necessarily be guided largely by convenience or, as in the case of the peach, by climatic conditions. As a rule, it is undoubtedly best to delay pruning as late as possible where there is danger of winter killing. In other cases, where this injury is not likely to occur, it may be advantageous and equally satisfactory to prune in the late fall or early winter. Convenience and climatic conditions must be taken into consideration in determining the period for pruning. In the removal of large branches, however, the work should be done at a season when growth is at its height, in order that the healing process may begin at once and continue as long as possible during the season in which the cut is made. For this reason it is a common practice among orchardists to remove large branches of the apple and pear about the time they come into bloom, which is also about the period of the beginning of active growth. The same rule will hold with ornamental deciduous trees, except that the period of blooming can not be taken as the basis. The gardener must observe the time when annual growth begins and regulate his pruning accordingly.

PRUNING BY PINCHING AND DISBUDDING.

"Pinching" and "stopping" are technical terms used in horticultural writings, which, although well understood by the initiated, have a very indefinite meaning to the general reader, at least in their horticultural application. Pinching or stopping is a method of summer pruning whereby robust shoots are checked at any desired height in their growth by removing their extreme points with a pinch between the finger and the thumb, without the further removal of foliage. This operation retards for a time the extension of such shoots, induces additional growths in other buds, and encourages the development of lateral shoots as well as of other shoots where a more active extension is required.

Disbudding.—By this term is meant the removal of superfluous buds, flowers, or shoots, in the early stages of growth, from fruit or other trees, in order to divert the sap into those which are stronger and are required

to remain either for the production of branches, flowers, or fruits of superior quality. It is of necessity very largely practiced with fruit trees under glass that have to be kept within a limited area, and where the crop of fruit and the continued vigor of the trees are annually matters of very great importance. The branches of figs, peaches, and vines, amongst many others, are each year so full of young shoots in spring, or at other seasons, when started into growth, that if all were allowed to remain, the result would be a dense thicket of useless branches.

Disbudding should always be performed with judgment, and only by those who understand it, as irreparable damage may easily be caused by the uninitiated. The operation should be commenced as soon as the young buds or shoots are large enough to pinch out with the finger and thumb, and the process should be frequently repeated, rather than an attempt made to remove many buds at a time. Many plants may with advantage be disbudded occasionally to thin the branches, for admitting more light and air, or for inducing a more compact habit. The disbudding of flowers, where crowded, if carefully performed when in an early stage, may also be recommended in some cases, particularly with the carnation and chrysanthemum.

Pinching and disbudding are the most rational modes of directing the growth of plants. If rigidly practiced there would be but little necessity for winter pruning or the removal of branches, small or large, at any time. It certainly seems an inconsistent practice to allow a tree to make growths of wood during summer to be cut out in winter by saw and pruning knife, thus sacrificing and destroying what it has been the aim of the cultivator to produce, leaving out of the question any injury to the vitality of the tree. Indeed, by proper attention to pinching and disbudding the amputation of branches will be rendered unnecessary, and the health of the plant will also be maintained, which is not the case where frequent pruning of branches is a routine practice.

Summer pruning.—The perfection of summer pruning provides for the complete control and disposition of growth without involving any material removal of foliage. When the extreme terminal bud of a growing shoot is removed growth will be checked without removing foliage and without injury to the vitality of the plant. The injury sustained by a rude and careless destruction of foliage is well exemplified in the management of grapes where the summer pruning is delayed until it is considered necessary to cut from 12 to 20 inches from the point of each shoot, so checking the plants that further growth will be slow and the fruit fail to mature, the berries remaining green until frost. Nothing is more certain than this, that the full and perfect maturity of fruit depends upon a full growth of healthy matured foliage.

PROTECTION OF WOUNDS.

No artificial medium can be applied to the surface of a wound which will induce it to heal more quickly. The activity of the healing process depends upon the character and position and the time of year when the wound is made rather than upon protective coverings.

Large wounds which result from the removal of branches of considerable diameter, leaving a large surface of heartwood exposed, may with advantage be protected by painting the cut surface with a heavy coat of white lead, the sole object of this precaution being to protect the heartwood from decay until the new growth, which forms from the growing tissue immediately under the bark, has had time to develop over the exposed dead wood and protect it from decay.

A large number of waxes, paints, and washes have been tried, and the conclusion of the whole matter may be summarized in the statement that any substance which is not corrosive or detrimental to growth which will protect the heartwood from the attacks of rot spores will prove a satisfactory covering for a cut surface. Among such substances may be mentioned white lead, yellow ocher, coal tar, and grafting wax.

TREATMENT OF HOLLOW TRUNKS.

It sometimes happens that a valuable shade or orchard tree becomes injured in such a way as to cause a cavity. This may have resulted from the breaking of a branch in a storm or from improper pruning. Whatever the cause the treatment is practically the same. All decayed or decaying matter should be removed from the cavity and with a sharp gouge or chisel all diseased wood cut away until sound heartwood is exposed. Then, before moisture or other injurious influences can act upon the newly exposed parts, the whole cavity should be filled with a thin mortar, made by mixing 1 part of Portland cement with 3 parts of clean, sharp sand. After the mortar has had time to become stiff, but not hard, a surface coat made of 1 part of sand and 1 part of cement should be added and the surface so faced as to exclude all moisture from the opening of the cavity. An additional safeguard would be had in treating the inside of the cavity with a copper-sulphate solution (1 pound to 5 or 6 gallons of water) after the diseased wood has been removed with a gouge or chisel and before the cement mortar is poured into the cavity.

PRUNING IMPLEMENTS.

DEVICES IN COMMON USE.

Since the operation of pruning involves the making of wounds and ready healing depends upon a smooth, uniformly cut surface, the selection of pruning tools is important. It is obvious that a tool which operates in the manner of a knife will leave such a surface as is desired; but it is not always possible, in pruning large trees, to use a simple knife. Where a knife will serve the purpose, as in the pruning of shrubs and small trees, the hawkbill knife (fig. 11) will be found most satisfactory. Where larger branches are to be removed, the hand-pruning shears (fig. 12), which consist of a strongly made shear which is opened by a spring, and the blade made of well-tempered steel and provided on the opposite side with a guard similar to that shown in fig. 13, are the most convenient device. Where still larger branches, which can be removed without a saw, are to be pruned, the lopping shears which are illustrated in fig. 13 can be most successfully and economically used. The one objection to both these forms of shears is that the cutting is done by a sort of crushing process, one side of the shear alone being provided with a cutting edge, the other being merely a rest or guard. Another type of shears has been designed but never put into general use which, instead of cutting by a simple crushing movement, cuts by a drawing movement, the blade being arranged on a sliding joint which provides for the drawing motion of a knife as the shears close.

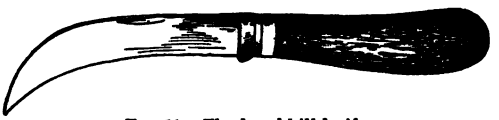

FIG. 11.—The hawkbill knife.

FIG. 12.—Pruning shears.

FIG. 13.—Lopping shears.

FIG. 14.—Hedge shears.

Shears for pruning hedges.—For the care of hedges, both deciduous and evergreen, the ordinary hedge shears, consisting of long straight blades with comparatively short handles, which are grasped in either hand, are most satisfactory. This type of shears is shown in fig. 14.

For high branches.—Where the pruning required consists of the removal of small branches high up in the trees, which can not be done by the operator standing upon the ground and which would necessitate the use of a ladder, the shears illustrated in fig. 12 have been modified so as to be attached to a pole in the manner shown in fig. 15, which enables an operator standing upon the ground to remove branches several feet above his head. These shears are subject to the same objection as those previously described, that they cut by a crushing process, but nevertheless they are exceedingly useful and economical for the removal of water sprouts and for cutting back leading shoots in tall trees.

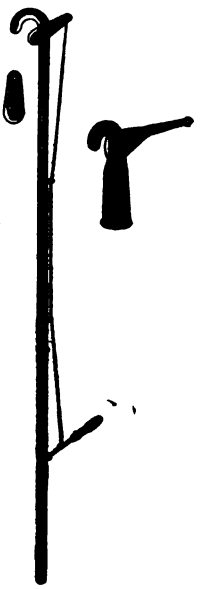

FIG. 15.—Device for cutting small limbs on tall trees.

Pruning saws.—Where the removal of large branches becomes necessary, a saw must be substituted for the knife or the shears. In such cases it is frequently desirable that the saw be so constructed that it will cut with a drawing motion rather than when pushed from the operator. There is a saw upon the market which combines both features, that of cutting on the downward stroke and on the upward stroke, one edge of the saw being provided with teeth for each motion. The blade of the saw is also curved, as shown in fig. 16, which enables one to reach some distance above his head and by drawing the saw toward him have it cut very freely on the downward stroke, which it would not do were it straight or provided with teeth set in the opposite direction. This type is exceedingly useful where the removal of branches of considerable size is necessary. Other forms of pruning saws are made to be used upon the end of a pole, and some are also provided with a chisel blade at one end so that they can be used for smoothing the cut surface after sawing off a branch, or for cutting off small water sprouts or branches in the same way that they would be cut with a hatchet. This method of removing branches, however, is not to be commended, as it is seldom possible to cut them close to their origin, which is, of course, necessary in order to secure the best results.

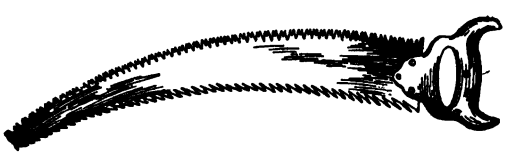

FIG. 16.—Double-edged curved-blade pruning saw.

THE PRINCIPLES OF PRUNING APPLIED TO SPECIFIC PLANTS

PRUNING THE APPLE.

In pruning a fruit-bearing plant like the apple attention must be given not only to the height and formation of the head, but to the removal of wood as well. The apple bears its fruit on spurs which are themselves developed from wood one year or more of age. For that reason, therefore, the removal of wood which carries fruit spurs reduces the crop the tree is capable of bearing. This then, is a practicable way of thinning the fruit. Besides accomplishing this result pruning can be used to lessen the annual growth and force the energy of the plant which would naturally be used in making wood into the fruit, thus increasing its size or enabling the tree to carry a larger quantity than would be possible were a normal wood growth permitted.

Forming the head.—Modern orchardists have come to look upon the low-headed tree as more desirable than those headed high. A head which is 2½ to 3 feet from the ground is at present considered more desirable than one which is 6 feet or more from the ground. The latter height was formerly frequently used. In forming the head care should be taken to have the framework branches disposed at different heights along the body of the tree—say from 3 to 6 inches apart, and distributed as evenly as possible around the body as a central axis; that is, when viewed from above the picture presented would be that of a wheel, the hub being the central axis of the tree and the framework branches representing the spokes, as shown in fig. 3, on page 13.

Main branches.—For an apple tree three branches are considered the ideal number. More may be left upon some varieties, particularly those which are strong growers and upon trees which have a well-developed root system at planting time. If, however, the roots have been badly mutilated in removing the tree from the nursery, it will be safer to reduce the number to three rather than to maintain a larger number. These three main framework branches upon the ordinary first-class nursery tree should not be more than 10 or 12 inches in length. At the close of the first season's growth after planting each one of these three framework branches should be considered as though it were a separate nursery tree and, if possible, three subdivisions of this should be maintained for the wood supply of the second year, the three branches retained being cut back to about the same length as those originally held by the tree as planted in the first place. This operation should be repeated each succeeding year. By so doing a symmetrical development can be maintained, and by cutting to an outside or an inside bud the habit of the tree can be modified so as to make it upright or spreading in character. Some trees are normally upright in their habit of growth, while others are spreading. This must be

borne in mind and the character of the variety under treatment must be taken into consideration in cutting the branches, so that they will be upright or spreading according to the desire of the planter.

Effect of cutting back.—This frequent cutting back of the branches of the tree while it is young prevents the long, bare branches which are so characteristic of old orchard trees. It also prevents the tree from growing too tall—a condition which makes it difficult to gather the fruit or to spray the tree. With the low-headed trees less propping is necessary than with trees having long framework branches. The load of fruit is carried nearer the trunk, and the main structural branches being larger in proportion to their length are therefore better able to carry any load of fruit which the tree may develop.

Annual and biennial crops.—Judicious pruning, as has been pointed out, not only facilitates the work of cultivation and spraying but at the same time determines to a very considerable extent the fruiting habits of the tree; that is, the quantity of bearing wood which a tree carries can be modified by pruning so that it will be practically impossible for the tree to retain more fruits in any given season than the root is capable of supplying with a proper amount of nourishment. With such a balance between the fruit-bearing wood of the tree and its root system maintained, biennial crops will be less likely and annual crops will be more common. Orchardists in general are coming to believe that the reason for the biennial crop in many orchards is due to the fact that during the crop year the trees are allowed to overbear and that their vitality is therefore so much reduced that it is impossible for them to carry a satisfactory crop the succeeding year. The thinning of the fruit, with the result that a crop is borne each year, has convinced practical growers that overbearing is the cause of the biennial fruit production.

PRUNING THE PEAR.

What has been said of the apple applies equally well to the pear; but, since pears are grown both as standards and dwarfs in commercial orchards, a consideration of the pruning of both classes is necessary.

Forming the head.—A low-headed pear tree is quite as desirable as a low-headed apple tree. In forming the head of the pear, however, more branches may be left than in the case of the apple. While three is given as the ideal number for the apple, as many as four or five may be retained by a well-grown pear tree. These should be distributed about the body so as to give practically an equal space between them, and, if possible, they should stand at different heights upon the main stem. The number of branches to be left upon any particular tree must, however, be determined by the condition of the root. If much root has been lost, a smaller number of branches should be

retained, and those retained should be shorter than in the case of a well-developed root. In general, however, the three, four, or five branches left upon the young pear tree should be shortened to about 10 or 12 inches in length. Each of these should, at the close of the first season, be treated as though it were a separate plant, and the number of shoots which it has developed be reduced to either two or three, and these in turn shortened to at least 12 inches in length. This operation should be repeated from year to year until the tree comes into full bearing, when less shortening will be required. In fact, as the tree grows older it will be found that, instead of retaining the original length of the annual shoots, they will reduce themselves in many cases to 6 or 8 inches in length. This is due to the fact that the energy of the root is distributed through a large number of branches, rather than to a few. By adhering to this system of pruning a symmetrical, broad-headed tree can be secured, and as fruit bearing increases the framework branches will tend to become more and more drooping.

Control of blight.—In addition to modifying the form of a tree by pruning, another and equally as important a factor can be controlled by this means. As is well known the pear ordinarily suffers severely from the pear-blight, but the work of Mr. M. B. Waite, of the U. S. Department of Agriculture, upon this disease has fully demonstrated the possibility of controlling it by judicious methods of pruning. As has been previously stated (p. 9), the pear-blight gains entrance to the tree in a majority of cases through the flowers, and as the flowers are borne upon spurs, and as these spurs are developed from wood which is one or more years of age, fruiting spurs frequently appear upon the pear on large branches. It therefore becomes evident that if these fruiting spurs are allowed to remain upon the large structural branches of the tree, and the blossoms of such a spur become affected by the pear-blight, the blight will immediately become communicated to the framework branch upon which the spur is situated. In consequence, a case of what is called "body blight" results. It is evident, therefore, that if the fruiting spurs which bear these blossoms are kept off the large branches of the tree there is less liability of injury to them from the blight. Persons engaged in pear culture should, therefore, pay the strictest attention to the removal of all fruiting spurs from the main structural branches of the pear tree. This will force the development of spurs upon the smaller branches, and as these can be allowed to develop at a considerable distance from the main body of the tree, contamination with the blight will only necessitate the removal of one of these smaller, minor branches, rather than the loss of a main framework branch. By systematically cutting out all blighted branches which appear among the fruit-bearing branches of a properly pruned

pear tree, it will at once rid the tree of the blight, without any serious detriment to the tree itself. This is the principle underlying the control of the much-dreaded pear-blight, and, as before stated, it is controlled primarily by judicious pruning.

PRUNING DWARF PEARS.

Dwarf pears are as a rule pruned as pyramids. For this reason the nursery trees are handled very differently from standards. Branches are allowed to grow close to the ground and a central axis clothed with branches from near the ground to its extremity is maintained rather than a bare trunk to the height at which the head is desired, as in the standard tree. In the pyramid these lateral branches are left longest near the ground and shortest near the apex of the pyramid. This method is adhered to from year to year in pruning the annual growth of the tree, as shown in fig. 4 (p. 14). The annual pruning of a pyramid is of even greater importance than in the case of the standard pear, for upon it depends the symmetrical development of the tree.

It is well known that orchard trees in general tend to make their greatest growth near the extremity of the leading branches. In other words, the leaders are the strongest growers and it is frequently a difficult task to stimulate lateral branches to grow sufficiently to preserve a symmetrical development in the tree. The manner, therefore, of cutting back the annual growth on the various parts of the tree must be carefully studied in order to preserve the symmetrical development desired. In removing the annual growth from pyramidal trees it should be the aim to cut back to an inside bud each year. This will tend to make the growth of the tree more upright and more compact, while with a vase-formed tree it should be the object to cut to an outside bud each year.

PRUNING THE PEACH.

In general, the peach is a stronger and more rapid grower than the apple or the pear. For that reason it is planted in the orchard at an earlier age than either. Yearling peach trees (see fig. 17) are considered more satisfactory by orchardists than older trees. These young plants are usually reduced to a single stem or whip at planting time, the head being formed from the shoots which develop along the body of the tree during the first year of its growth. (See fig. 18.) It is an easy matter to go over the newly planted tree and rub off such shoots as are not desired.

Forming the head.—Practically the same rule that holds for forming the head of the apple and the pear is adhered to in forming the body branches of the peach, three or four being the number most frequently

used. These shoots are, at the close of the first season, shortened back to about 1 foot in length and are allowed to divide into three or four branches during the next season's growth. The same heading-back and multiplication of the branches takes place the next year. At planting time, however, the main stem of the tree, which carries the roots but no lateral branches, as shown in fig. 18, is seldom more than 2 feet in height, so that when the framework branches develop from it the head of the tree is not more than 18 or 20 inches from the ground. This arrangement enables workmen standing upon the ground to gather the fruit during the first three or four years of the fruit-bearing period. As the tree grows older and the branches become longer, it is necessary to employ picking stands of some description. The best growers, however, systematically shorten the annual growth of all of their orchard trees.

FIG. 17.—Peach tree from the nursery.

Freezing.—In the Southern States, where trees are not likely to be injured by freezing, this pruning can be done during the fall or early winter, but in the northern portions of the peach-growing area of the United States it is best to delay heading-in until all danger of winter killing is past. It frequently happens that the freezes are severe enough to reduce the annual growth as much as it is desirable to reduce it by pruning, and had the pruning been done before the freezing occurred there might have been an entire loss of the peach crop; but when pruning is delayed until all danger of freezing is past the pruning can be gauged so as to reduce the fruit-bearing wood in proportion to the capacity of the tree, for, as is well known, the peach bears its fruit upon wood of the last season's growth rather than upon fruit spurs, as in the case with the apple and pear. For this reason, therefore, the heading-back of peach trees plays an important part in thinning the crop.

FIG. 18.—Peach tree pruned for orchard planting.

Shape of the tree.—Ordinarily it will be found most satisfactory to prune the peach so as to make a broad, round-headed tree rather than a pyramidal or vase-shaped tree. In certain localities the vase-shaped

tree may be found the most desirable, but as the fruit is always borne on the outside or upon the new wood of the tree, it is in a position to receive full sunlight, and the open-headed vase-shaped form is therefore less desirable than in the case of fruits which are borne well inside the tree.

PRUNING THE PLUM AND THE CHERRY.

Habits.—The habit of the plum to bear early and abundantly under favorable conditions limits its annual growth to such an extent that after the bearing age is attained little annual pruning is necessary other than to remove dead or interfering limbs or to head back an occasional strong shoot which may appear from time to time in the center of the crown. The plum, as well as the cherry, has the annoying habit of occasionally producing strong shoots from adventitious buds along the trunk of the tree or from near the surface of the ground. A close watch should be kept for such interlopers in order that they may be promptly removed.

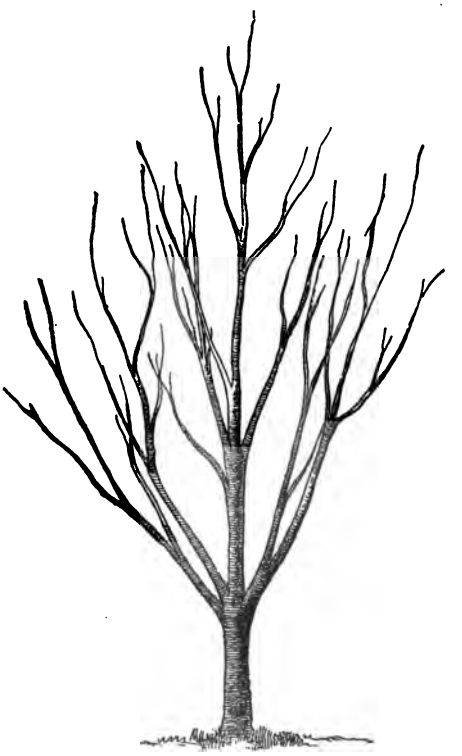

FIG. 19.—Sweet cherry properly pruned.

Framework.—During the early years of the growth of both of these plants care should be exercised to secure a proper distribution of the limbs which are to form the framework branches of the tree, particularly with the Japan plums and the sweet cherries, as both these species have the unfortunate habit of dividing into two shoots of nearly equal size with a close angle between, which always forms a weak joint. Trees not carefully pruned to overcome this bad habit are liable to severe injury from splitting when heavily loaded with fruit.

Cutting back.—In the early period of the growth of both the Japan and American plums, as well as the sweet cherry, the annual growth will need more or less severe cutting back, depending upon soil and climatic conditions, in order to maintain them within bounds. On

general principles this heading should be done just before growth starts in the spring.

Form of tree.—The form of a well pruned sweet cherry is shown in fig. 19 and a sour cherry with its drooping habit in fig. 20. The European plums (*Prunus domestica*) do well when trained after the general fashion of the peach. In general, however, the main trunk of the plum should be somewhat longer than that of the peach, in order that the work of jarring for the curculio may be facilitated if the orchard happens to be located where this operation is necessary.

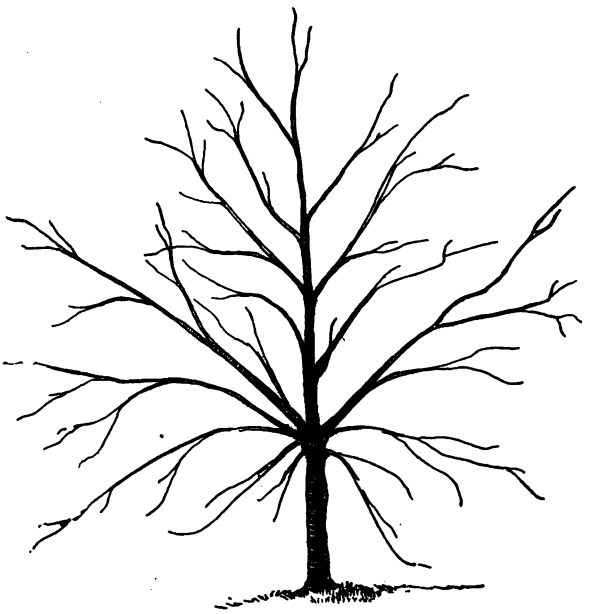

FIG. 20.—Sour cherry; good form.

Fruiting habits.—The fruiting habits of the plum and the cherry are more closely allied to those of the apple and the pear than to the peach, and for that reason the shortening of the annual growth is of less moment with these plants than with the peach.

PRUNING THE GRAPE.

In no fruit crop does pruning play so important a part, both as regards the quantity of fruit borne and the cost of producing it, as with the grape. In fact the manner of pruning employed determines to a very large extent the cost of maintaining a vineyard. Certain styles of pruning require a large expenditure of money in the construction of supports or trellises and an equal outlay each season for tying, both early in the season and during the summer. Other systems require less expensive trellises, and little or no expenditure of time or money in spring and summer tying, thus making a very considerable difference in the cost of producing a good quantity of fruit and, since grapes have, during the last decade, become so cheap, the margin of profit left to the grower over and above the cost of production is very small, even when the most economical systems of training are employed.

Systems used.—In this connection two of the important systems

used by eastern grape growers will be described, namely, the Kniffen system (figs. 21 and 22) and the high-renewal system (fig. 23). The first named requires no greater outlay for trellises than does the

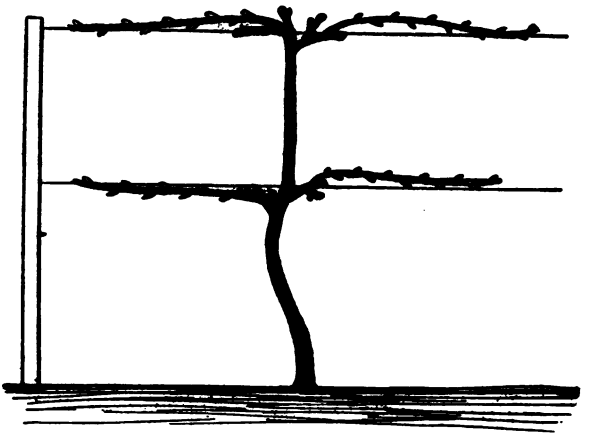

FIG. 21.—Vine trained by Kniffen system; single stem.

second, but permits of growing the crop with very much less summer tying than is required by the high-renewal system.

The Kniffen system.—Plants pruned on the Kniffen system are shown in figs. 21 and 22. It will be noted that the long trunk employed

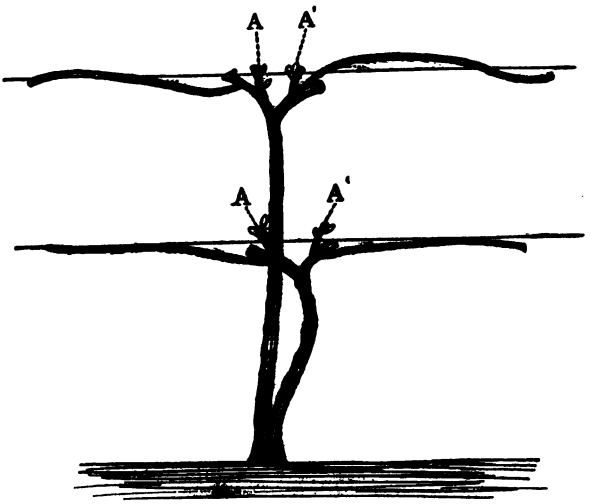

FIG. 22.—Vine trained by modified Kniffen system; two stem.

in the Kniffen system carries the fruiting branches far above the ground. This permits the annual growth to fall from the supporting wires in a natural way without the necessity of tying. This consti-

tutes the chief advantage of this system over any other employed in the eastern grape belt. Another slight advantage which the Kniffen system has over the high-renewal or the renewal system is that the fruits are farther from the ground and experience teaches are less liable to injury from mildew and rot. They are also somewhat easier to spray, although there is comparatively little difference in this regard between the Kniffen and the high-renewal systems.

The Kniffen system, then, consists in the carrying of either one or two main trunks to the height of 3 to 5 feet above the ground; sometimes they are carried to the height of 6 feet or more. If two trunks are employed, one is carried 6 feet or more above the ground and the other about 18 or 20 inches lower, as shown in fig. 22. It is not desirable to attempt to make the two stories on a single trunk, as the laws of growth induce development at the extremity of the cane and therefore the set of branches which is lowest upon a common trunk makes little or no development, growth being confined almost entirely to the uppermost set of branches. When two trunks are employed, however, the case is different and each set of branches becomes, as it were, terminal branches, and a much more satisfactory growth results.

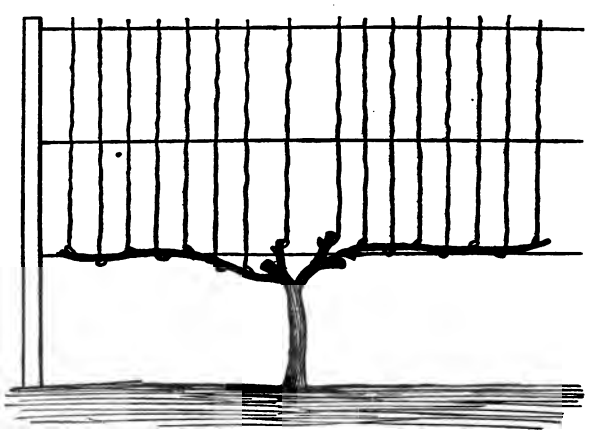

FIG. 23.—Vine trained by high-renewal system.

The method of renewal employed in the Kniffen system is practically the same as that in the high-renewal system; that is, the canes which are to bear the fruit during the next season are selected from wood which developed the previous year. These canes are cut back to six or eight buds and are tied to the central wire of the overhead trellis. At the close of the season the bearing cane is removed and a new shoot, one developed from near the head of the trunk, is used to replace it during the succeeding year. The same treatment is employed for the other side of the head; that is, the T-head at the top of the trunk on the Kniffen-trained vine serves the same purpose as the T-head at the top of the trunk of the high-renewal vine. The style of pruning, the construction of the trellis, and the method of renewing the wood are all illustrated in figs. 21 and 22.

The high-renewal system.—The high-renewal system of training

equires a trellis consisting of three or more wires or other suitable supports carried by posts or stakes placed at convenient distances apart in the row of grapevines, the vines themselves being planted 8 or 10 feet apart in the row. The first or lowest wire upon the trellis is usually 18 or 20 inches from the ground. The next is about 18 inches higher, and the third about 2 feet still higher. The main trunk of the vine is carried to the height of the lowest wire or support. From it a cane carrying about eight buds is trained in either direction along the lowest wire. From each of these buds shoots develop which bear the crop of the season; but as these shoots are seldom able to care for themselves they must be tied to the upper supports of the trellis, as shown in fig. 23.

It will be noted from this that the summer tying of plants trained on this system is very much greater than with plants trained on the Kniffen system. From the T-head, which, as has been stated, is carried to the height of the lowest wire, canes are carried in both directions along the lowest wire and are firmly tied to it. Near the base of each of these canes, but upon the older wood of the T-head, short spurs carrying two or three buds are maintained, from which shoots develop which, in turn, are usually employed to furnish the fruiting canes of the succeeding year; that is, the spurs are the means of renewing the fruiting wood of the vine grown on the high-renewal system. The same plan can be and frequently is employed with the Kniffen system. The pruned vine shown in fig. 22 indicates at *A* and *A'* the position of the two spurs that are to furnish the fruiting canes after those which are at present tied to the wires have completed their usefulness; and, as these canes are useful during only one year, the fruiting wood is provided for by a set of spurs each season.

PRUNING THE RASPBERRY.

In many sections of the country the black raspberry as well as the red raspberry is extensively cultivated for commercial purposes and also for family use. When grown upon a commercial scale the plants are set in rows 6 or 8 feet apart and 3 feet apart in the row. With this style of planting and judicious pruning no trellis is necessary.

The first step.—The usual plan is to allow the young shoots which annually spring up from the root of the plant to grow to the height of 2 feet or a little more. When the shoots have attained this height the first step in the pruning of the raspberry begins by breaking off 3 or 4 inches of the topmost portion of the shoot, leaving it 20 to 22 inches in height. The rapidly growing succulent shoots snap off easily between the thumb and finger, and as a rule no shears or other pruning device will be found necessary to accomplish this heading-in. As a result of the check sustained by breaking off the terminal bud,

the stalk thickens, the leaves grow larger, the axillary buds near th end of the stalk increase in size, and soon lateral shoots develop fro them. As a rule, five or six of the topmost buds push out and instead of having one sturdy stalk several feet in length which woul carry one-half dozen fruit clusters near its tip the succeeding season pruning has restricted its height to 20 or 22 inches and has induce the formation of five or six lateral shoots, each of which may grow t be as much as 18 inches or more in length before the close of the sea son and, instead of a single cane for fruit production, there are five o six, each of which will carry as many fruit clusters as would hav been produced by the original shoot had it been left t itself. Here, then, is an example of pruning inducin fruitfulness.

FIG. 24.—Pruning hook for brambles.

Removing old wood.—The second stage in pruning th raspberry consists in cutting out all the wood which i older than the present season's growth. This pruning should be done immediately after the season's crop ha been harvested. If done at this period it is easy to distinguish the fruiting wood from that which has grow during the season, and by taking out all the useless wood at this time the whole energy of the root is reserved fo the new growth which is to supply the crop next season. For cutting out this wood a special implement made i general like the one shown in fig. 24 is employed. A cutting edge is provided on the hook which reduces it to a hawkbill knife, and as well upon the chisel-shaped portio upon the back. In one case the implement serves the purpose of a brush hook on a small scale and in the other, when the chisel blade is used, it serves as a spud.

Lateral branches.—A third step in the pruning of the raspberry is shortening the lateral branches which have developed from the headed-in shoot. This work is usually done in the spring before or at blooming time, and is for the purpose of regulating the crop as well as reducing the wood so as to enable the cane more easily to support the fruit and to make the work of harvesting more easy.

New growth from roots.—From what has been stated it will have been inferred that the raspberry bears its fruit most abundantly upon wood 1 year of age, and that older wood is of little or no use and should be cut out for the good of the plant. There are exceptions to the rule, for raspberries frequently bear a few fruits upon the new shoots which annually come up from the root of the plant when those shoots are allowed to grow unchecked; but as this forms a late or second crop, and as it does not occur as a fixed habit of the plant but rather

s a result of peculiar weather conditions, it is never taken into account n commercial raspberry culture.

Results of pruning.—The shortening of the shoots to 2 feet or less in eight, together with the thickening which follows, renders them able o support a crop of fruit without the aid of a trellis. Fig. 25 gives n idea of the appearance of a black raspberry bush at the close of the eason after the shoots have been headed back and lateral branches developed, and after he old wood has been removed.

FIG. 25.—Typical raspberry after pruning.

PRUNING THE BLACKBERRY.

In general, the pruning of the blackberry is the same as that of the raspberry and, except to stop the annual growth higher than the raspberry, no modification of the directions given under that head need be made.

PRUNING CURRANTS AND GOOSEBERRIES.

If ease of cultivation were the only consideration in pruning currants and gooseberries, the tree form would certainly be most convenient and economical. Unfortunately the grower has no choice in this matter, for in order to insure his plants against the ravages of borers of the root and stalk it is necessary to train both these plants in a bush form. When managed in this way new wood can annually be induced to spring up from the root to replace any canes which may be destroyed by borers or which may for any other cause become useless to the plant. The new growth should be stopped when it reaches a convenient height, in order to induce the formation of side branches and thus increase the area of bearing wood. This is much more important than would at first appear, because the fruit of these plants is borne upon fruiting spurs which develop from wood two or more years of age. On the other hand, the renewal of the bush is not only necessary in order to maintain it against insect pests, but to insure a supply of fruit-bearing wood to take the place of the old wood which it has become unprofitable to maintain.

Currants.—In general a currant bush should be composed of from five to eight stalks, stopped about 18 to 20 inches in height. If the

plants are vigorous, shoots stopped at this height will produce several lateral branches, thus forming a compact, broad-headed bush with a maximum expanse of bearing wood.

Gooseberries.—The gooseberry should be treated in like fashion, but will be found to require less heading-back, because its normal habit is to produce numerous side shoots rather than strong, upright ones.

PRUNING HEDGES.

The following paragraphs, except that on pruning trees for timber, are summarized from a paper entitled "Pruning Trees and Other Plants," by William Saunders, appearing in the Yearbook of the Department of Agriculture for 1898:

Form.—One of the best forms for a hedge which is to serve either as a fence, windbreak, or as an ornament is the pyramid.

Shaping the hedge.—When the plants are first set out in line they should be pruned or shortened to within 2 or 3 inches of the ground and allowed to grow undisturbed during the first season. At the end of the yearly growth the plants should again be pruned down to within 6 or 8 inches of the first pruning, any side or horizontal growths being pruned within an inch of the main stem. During the growth of the second season the hedge may be partially shaped by an occasional pinching out of the points of stronger upright shoots, but preserving every shoot and leaf on the weaker side growths. In thus repressing the upright shoots and encouraging side growths a breadth of base will be secured which at this stage is most important. During the following winter the hedge, if it has progressed favorably, may be pruned into shape—that is, formed into a pointed pyramid, the sides being from 8 to 10 inches from the center.

These operations are in accordance with the principles that summer pruning will arrest growth to some extent, and that winter pruning will encourage the production of strong growths. By keeping these factors in view a hedge can readily be shaped without much destruction of growths and as readily maintained in a pyramidal form; but if the more upright or top shoots are allowed to predominate the lower side shoots will soon lose vigor, and thus the hedge will lose its efficiency as a barrier and its beauty as an object of ornamental utility. These details apply to deciduous plants, of which the Osage orange is an example.

Pruning evergreens.—Evergreens, such as the arbor vitæ, require less labor in preparation or training and maintenance than deciduous plants, as most of them naturally assume a pyramidal form, and by a practice based upon the principles already noted good hedges can easily be produced. The main points are to keep the top of the hedge shaped to a point and allow the sides to expand sufficiently, so that all parts

of the hedge surface may be exposed to light. Very rarely will it be necessary to trim more than once a year, and the best time for the work is just before the commencement of growth in spring. When the hedge has attained a height of 5 feet, it should be about 3 feet wide at its base or at the surface of the ground, and all pruning should be directed with a view to securing this form.

PRUNING STREET TREES.

Form.—The ideal street tree is one having a straight, well-defined central stem throughout its entire length, with side branches regularly disposed around it and subordinate to it. Trees grown in this shape will withstand fierce storms and sudden bursts of wind without injury. Not many deciduous trees naturally assume this form, but by timely pruning when young they can be greatly helped to approach it.

Shaping the tree.—This training process should commence while the tree is young and its growth easily controlled. Not later than the second year after planting a careful inspection should be made after the leaves fall, and if more than one shoot seems developing to leaders, select the fittest and remove the tops from the others; also cut the points of any side branches that appear to require checking, so as to maintain symmetry in the tree.

When training should begin.—Practically, the training process should commence in the nursery, where the growth of a leading shoot should be maintained and all side branches kept back by pinching their points. These branches should not be removed entirely, as they tend to strengthen the main stem, and can be removed later. The tree should remain under nursery culture until it has reached a height of 8 to 10 feet, and at transplanting all the side shoots should be removed by cutting them close to the main stem to a height of at least 6 feet. No further pruning will be necessary at this time.

Lower branches.—The removal of all lower branches is rendered necessary in order that they may not interfere with the proper use of the sidewalks and streets, but such removal has a tendency to weaken the main body of the tree and diminish its powers of resistance against the sweeping blasts to which street trees are oftentimes subjected. This trimming up from below will require attention for a number of years, because as the lower branches extend they will droop at the ends and become an interference. The points of these drooping branches may be removed for a time, but this will afford only temporary relief, and ultimately the whole branch will have to be removed by cutting it off close to the main stem; but this should not be done until it becomes absolutely necessary.

Large trees.—The best method of pruning large trees in cities is sometimes a difficult question to decide. As a rule, the worst treat-

ment they can receive is to cut off their tops, "heading down," as it is termed. When this involves the removal of heavy branches, so as to leave a mere skeleton of stumps, it not only destroys the beauty of the tree but induces decay, especially with trees that do not speedily send out growth immediately below the cut. Heading down is objectionable in so far as it causes a low, dense growth, not desirable even as shade, and increases the liability to destruction from windstorms.

Crowded trees.—When trees become thickly branched and crowded as to space they are not improved by cutting the ends of the shoots, which merely aggravates the evil. They should rather be judiciously thinned by the complete removal of some of the branches. A skillful operator will remove one-third or more of the branches of a thickly set tree so that the ordinary observer will not perceive that any pruning has been done, the tree looking as natural in its ramifications as if it had not been disturbed; and this should be the aim in all pruning operations as applied to street trees.

Buttonwood trees.—There are some trees that respond more satisfactorily than others after severe cutting back. Of these the two species of *Platanus* (buttonwood), *P. occidentalis* and *P. orientalis*, may be specially mentioned. They are well fitted for wide streets or avenues. Their branches are widespreading and far-reaching, and they should not be set within 25 feet of a building; even at that distance the horizontal branches may, after a growth of ten or twelve or more years, become objectionably large, but they can then be pruned back with great advantage. This pruning is performed by cutting back the lower branches to within, say, 8 feet of the main stem, gradually shortening this distance as the operation proceeds upward until it terminates in a point at top. Trees treated in this way will start young growths at every cut regularly and evenly over the entire system, and after the growth of one year will present a mass of fine foliage, bringing out fully the pyramidal shape, which will increase in beauty for many years without further attention as to pruning. Perhaps no other trees will endure this kind of cutting back so well as these buttonwoods.

PRUNING TREES FOR TIMBER.

In growing trees solely for the sake of their timber very little pruning will be required, and that mostly to regulate growths when the trees are young, the object being to secure lengthened, clean trunks, instead of short stems and bushy tops. An upright leading shoot should be encouraged and all other branches kept subordinate. In the case of a young tree producing several upright or leading branches, the best placed and most central should be selected as the permanent leader and all others discarded by pruning them back close

to the trunk. Trees that are planted purposely for timber are set quite closely, so that they may become crowded and their tops drawn up towards the light. The side branches, being in the shade, die off and in this way natural pruning is effected. Of course, the trees are thinned when they become overcrowded by cutting out any inferior, partly suppressed, or misshapen specimens. After the formative youthful period in the life of a forest has been passed, it is only practicable to prune off branches 2 inches or more in diameter from the individuals in the stand which have been selected for the final crop. Such pruning should be made close up to the trunk. Pruning should be done at a season in the year when the wounds will heal over in the shortest possible time. To prevent germs of decay from gaining an entrance through wounds caused in this way, it may be practicable to coat the wounds with coal tar.

PRUNING FLOWERING SHRUBS.

The only pruning that may be considered essential for ordinary shrubbery is that of thinning out the plants by removing old branches that are about destitute of young growths. The worst treatment they can receive is that of shortening the summer growths during the fall, especially that of shearing them into round, stubby forms with hedge shears, at once destroying the natural, graceful beauty of the plants and removing the best of their flowering shoots just as they are preparing for an abundance of blossoms. For example, the Forsythia, usually a free-growing, hardy plant, will make shoots several feet in length during summer, will be covered with flower buds toward fall and prepared to blossom profusely early in the following year. Any pruning which shortens the shoots simply removes the flowering wood and can not in any degree benefit the plant. Deutzias, Spiræas, Weigelas, and similar flowering shrubs require the same kind of treatment. The bushes should be kept rather open, so that the branches may receive full benefit of light and air. This is effected by pruning out some of the oldest branches or thinning out some of the young shoots where they are too dense, and these should be cut close to the base of the plant, which will encourage the growth of vigorous flowering branches, thus keeping the plant floriferous from year to year.